

Claims

What is claimed is:

1. Hydraulic transmission system, comprising:

a supply means adapted to supply a variable flow rate of hydraulic working fluid; said supply means having a hydraulic adjustment device for adjusting the variable flow rate of the hydraulic working fluid;

an actuatable hydraulic control having an actuated condition in which the actuatable hydraulic control generates a hydraulic control fluid having a control pressure which is adjustable between a first control pressure and a second control pressure;

a first connection control operable by said hydraulic control fluid supplied from said actuatable hydraulic control and adapted to direct, upon actuation of said actuatable hydraulic control, said hydraulic control fluid to said hydraulic adjustment device; and

wherein said first connection control includes a distributor connected to said hydraulic adjustment device, said distributor having a control position in which it directs said hydraulic control fluid to said hydraulic adjustment device upon actuation of said actuatable hydraulic control, said distributor further having a neutral position in which it connects the hydraulic adjustment device to a hydraulic fluid tank.

2. The hydraulic system, as set forth in claim 1, including:

at least two working lines receiving said hydraulic working fluid at variable flow rate from said supply means;

at least two hydraulic users connected to said supply means via said at least two working lines in a closed circuit configuration;

a second connection control adapted to control the connection of working line portions connected to the at least two users;

said actuatable hydraulic control being adapted to generate a control signal indicative of a desired flow rate of the hydraulic working fluid supplied by said supply means, and

said second connection control being responsive to said control signal so as to selectively provide serial and/or parallel connection of the at least two hydraulic users by selectively connecting said working line portions.

3. The hydraulic system, as set forth in claim 2, wherein said control signal is the hydraulic control fluid with variable pressure supplied by said actuatable hydraulic control.

4. The hydraulic system, as set forth in claim 3, wherein said actuatable hydraulic control has at least first and second control outputs supplying hydraulic control fluid and being associated with respective first and second modes of operation of the hydraulic transmission system.

5. The hydraulic system, as set forth in claim 1, wherein said distributor includes a pilot operated directional distributor valve having a distributor pilot line connected to said hydraulic control fluid from said actuatable hydraulic control and being movable into said control position upon supply of said hydraulic control fluid on said distributor pilot line so as to selectively direct said hydraulic control fluid from said actuatable hydraulic control to said hydraulic adjustment device.

6. The hydraulic system, as set forth in claim 5, wherein said first and second control outputs are connected to first and second distributor pilot lines of the directional distributor valve to move the distributor valve in an associated first or second control position, said hydraulic adjustment device being responsive to the first or second control position so as to cause said supply means to supply said hydraulic working fluid in a selected one of first and second flow directions in the hydraulic system, said first and second flow directions being associated with said first and second control positions.

7. The hydraulic system, as set forth in claim 1, wherein said first connection control includes a first switching adapted to connect a supply line of said distributor to the hydraulic control fluid from the actuatable hydraulic control in response to actuation of the actuatable hydraulic control.

8. The hydraulic system, as set forth in claim 7, wherein said first switching device is adapted to connect said hydraulic adjustment device to a supply of hydraulic fluid having constant pressure in the non activated condition of the actuatable hydraulic control and to disconnect said supply of hydraulic fluid having constant pressure from the hydraulic adjustment device in the activated condition of the actuatable hydraulic control.

9. The hydraulic system, as set forth in claim 8, wherein said first switching device is a pilot operated directional on-off valve having an activated position in which the directional on-off valve directs said hydraulic control fluid from said actuatable hydraulic control to the distributor.

10. The hydraulic system, as set forth in claim 9, wherein said directional on-off valve further has a neutral position in which it connects said

hydraulic adjustment device to said supply of hydraulic fluid having constant pressure.

11. The hydraulic system, as set forth in claim 10, wherein said directional on-off valve has a first pilot line selectively connectable to the hydraulic control fluid of the actuatable hydraulic control means, said directional on-off valve being movable to its activated position upon receiving hydraulic control fluid on said first pilot line.

12. The hydraulic system, as set forth in claim 11, wherein said hydraulic system includes a second switching device adapted to connect the first pilot line of the directional on-off valve to a selected one of the first or second control outputs of the actuatable hydraulic control.

13. The hydraulic system, as set forth in claim 12, wherein said second switching device includes first and second check valves having their respective inputs connected to the first and second control outputs of the actuatable hydraulic control and having their respective outputs connected to the first pilot line of the directional on-off valve.

14. The hydraulic system, as set forth in claim 13, wherein said second switching device selectively directs hydraulic control fluid of one of the first and second outputs of the actuatable hydraulic control to a control fluid input of the directional on-off valve, said control fluid input being connected to a control fluid output of the directional on-off valve in its activated position.

15. The hydraulic system, as set forth in claim 14, wherein said supply means includes a variable displacement pump of the axial piston type with swash plate design and said hydraulic adjustment device includes a double acting servo piston connected to said variable displacement pump.

16. The hydraulic system, as set forth in claim 15, wherein, in said control position, said directional distributor valve directs said hydraulic control fluid from the actuatable hydraulic control to an associated one of the piston chambers of the servo piston.

17. The hydraulic system, as set forth in claim 16, wherein said directional distributor valve has a neutral position in which no hydraulic control fluid is supplied to the distributor pilot line, and wherein said neutral position of said directional distributor valve connects both chambers of the servo piston to a tank to balance the position of said servo piston.

18. The hydraulic system, as set forth in claim 2, wherein said actuatable hydraulic control generates said hydraulic control fluid at continuously variable pressure between said first control pressure and said second control pressure; and

wherein said second connection control is adapted to control the connection of the working line portions so as to change substantially smoothly from a serial connection configuration at the initial control pressure to a parallel connection configuration at the maximum control pressure.

19. The hydraulic system, as set forth in claim 18, wherein said second connection control includes a directional valve having a first extreme position in which it connects the working line portions in a serial connection configuration of the at least two users and having a second extreme position in which it connects the working line portion in a parallel connection configuration of the at least two users, said directional valve being adapted to change its position responsive to the control signal.

20. The hydraulic system, as set forth in claim 19, wherein said directional valve is proportional and changes its position from the first

extreme position to the second extreme position responsive and proportional to said control signal.

21. The hydraulic system, as set forth in claim 20, wherein said directional valve is a 6-way proportional valve adapted to depressurize the working line portions connected in a serial connection configuration when changing its position from the first extreme position to the second extreme position.

22. The hydraulic system, as set forth in claim 21, wherein said directional valve is pilot operated by said hydraulic control fluid supplied by said actuatable hydraulic control.

23. The hydraulic system, as set forth in claim 22, wherein said directional valve has a second pilot line selectively connectable to the hydraulic control fluid of the actuatable hydraulic control, said directional valve being movable from the first extreme position towards the second extreme position dependent on said varied pressure of said hydraulic control fluid.

24. The hydraulic system, as set forth in claim 23, wherein said first and second control outputs of said actuatable hydraulic control are selectively connectable to said second pilot line of said directional valve.

25. The hydraulic system, as set forth in claim 24, wherein said second switching device of said hydraulic system also is adapted to connect the second pilot line of the directional valve to a selected one of the first or second control outputs of the actuatable hydraulic control.

26. The hydraulic system, as set forth in claim 25, wherein said second switching device includes first and second check valves having their

respective inputs connected to the first and second control outputs of the actuatable hydraulic control and having their respective outputs connected to the second pilot line of the directional valve.

27. A method for controlling a hydraulic transmission system, said hydraulic transmission system having a hydraulic pump for supplying hydraulic working fluid at variable flow rate; wherein said pump includes a hydraulic adjustment device for adjusting the variable flow rate of the hydraulic working fluid;

said method comprising the steps of:

providing a hydraulic control fluid having a control pressure which is adjustable between a first control pressure and a second control pressure, said control pressure being indicative of a desired flow rate of the hydraulic working fluid;

selectively directing said hydraulic control fluid during an actuated condition to said hydraulic adjustment device, and

operating said hydraulic adjustment device by means of said hydraulic control fluid; and

wherein said actuated condition during which said hydraulic control fluid is selectively directed to said hydraulic adjustment device corresponds to providing said hydraulic control fluid with said first control pressure.

28. The method, as set forth in claim 27, including the step of, in a non-actuated condition, providing hydraulic fluid at constant pressure to said hydraulic adjustment device and connecting the same to a tank of hydraulic fluid.

29. The method, as set forth in claim 28, wherein said hydraulic transmission system includes a first connection control adapted to selectively direct said hydraulic control fluid to said hydraulic adjustment device, said method including the step of operating said first connection control by said hydraulic control fluid.

30. The method, as set forth in claim 29, wherein said hydraulic pump is adapted to supply hydraulic working fluid at variable flow rate to at least two working lines, and said hydraulic system includes at least two hydraulic users connected to said pump via said at least two working lines in a closed circuit configuration; said method further comprising the steps of:

providing a control signal indicative of a desired flow rate of the hydraulic working fluid supplied by said pump;

controlling the connection of working line portions connected to the at least two users so as to selectively provide serial and parallel connection of the at least two hydraulic users in response to said control signal.

31. The method, as set forth in claim 30, wherein said control signal is continuously variable between a first control signal value and a second control signal value; and wherein said connection of the working line portions is controlled so as to change substantially smoothly from a serial connection configuration at said first control signal value to a parallel connection configuration at said second control signal value.



32. The method, as set forth in claim 31, wherein said connection of the working line portions is controlled by a second connection control operated by said control signal.

33. The method, as set forth in claim 32, wherein said second connection control is operable by a hydraulic pilot pressure, wherein said control signal is provided in the form of said hydraulic control fluid having variable pressure corresponding to the desired pressure of the working fluid, and wherein said method further includes the step of pilot operating said second connection control by said hydraulic control fluid.